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Biodegradability of pristine and weathered car tire particles and their individual components

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The wear of car tires is a contributor to particulate matter pollution, chemical pollution, and microplastics pollution. Tire wear particles are generated from the interaction between tire tread and road surface and released into the environment. The tire tread consists of a polymeric blend of natural rubber (NR), isoprene rubber (IR), butadiene rubber (BR), and styrene-butadiene rubber (SBR), compounded with carbon black or silica as a filler, along with extender oils, and additives responsible for vulcanization and protection.

Biodegradability of car tire rubber was investigated following the OECD 301F guideline and using OxiTop® instrumentation to determine complete mineralization under aerobic conditions. Pristine and UV-weathered tire particles were tested using both activated sludge and soil as inoculum. Effects of particles size (< 63 µm, 63-90 µm, or 90-125 µm) and inoculation time (4 or 11 weeks) was investigated. To asses biodegradability of individual components the following materials were tested: devulcanized tread particles (DTP), NR, IR, BR and TDAE oils.

Pristine and weathered rubber exhibited low but measurable biodegradation levels in the presence of activated sludge (3.8-7.6% ThOD) and soil supernatant (0.8%-2.3%). No relation between particle size and biodegradability could be established, likely due to similarity in sizes. Extending the inoculation time from 4 to 11 weeks increased the biodegradability from 6.7% to 9. No improved biodegradability was found when comparing DTP (3.46%) to tire particles (4.13%). Of the individual substrates, NR showed the highest degree of biodegradation (34.32%), followed by TDAE (7.13%). BR and IR showed no or negligible biodegradation.

Overall, ready biodegradability tests proved suitable to obtain information on degradation of car tire rubber. The findings of this study provide a starting point for understanding the environmental fate of tire wear particles, providing an insight into the degradability of the tire wear rubber as well as its individual components.